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WATERSHED WORK PLAN

WILSON SPRING CREEK WATERSHED

Wilson County, Tennessee

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

[redacted]

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Prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Wilson Spring Creek Watershed District

Wilson County Soil Conservation District

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

January 1965

TABLE OF CONTENTS

WATERSHED WORK PLAN
WILSON SPRING CREEK WATERSHED
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SUMMARY OF PLAN

This document is a plan for watershed protection and flood prevention in the 40,040-acre (62.6 sq. mi.) Wilson Spring Creek Watershed located in Wilson County, Tennessee. The plan was developed by the Wilson Spring Creek Watershed District and the Wilson County Soil Conservation District. The United States Department of Agriculture, Soil Conservation Service, and Forest Service, provided assistance under the provisions of Public Law 566.

The primary problem of the watershed is flood damage to crops, pasture, fences, roads, bridges, rural property, other fixed improvements, and flood plain scour. Some portions of the main flood plain begin flooding following rainfall of about 1.35 inches within a 24-hour period. The largest storm in the 20-year evaluation period caused flooding on 4,187 acres of land.

The objectives of the sponsors are: (1) a significant improvement in establishing soil and water conservation measures; (2) a reduction in flooding on two-thirds of the flood plain so that the production of cultivated row crops, hay or pasture, in rotation, can be managed more intensively at least two years out of three; (3) flood damage to roads and bridges, rural property and minor fixed improvements be reduced to a minimum; and (4) to maintain the present fishery resources in Spring Creek.

The planned works of improvement to be installed during a four-year period are, (1) the application of needed conservation measures on 8,300 acres of land for watershed protection, (2) the installation of one floodwater retarding structure and the improvement of 305,000 feet of stream channel for flood prevention and (3) the installation of mitigating measures that temper or reduce damages to fish habitat.

The total estimated installation cost of the project is $1,183,708, of which $733,523, or 62 percent, will be P. L. 566 funds and $450,185, or 38 percent, will be Other funds.

The total estimated installation cost of all land treatment measures is $296,628; $36,000 from P. L. 566 funds for technical assistance and $260,628, Other funds. All land treatment measures will be planned and applied farm by farm by the landowners and operators at their own expense in cooperation with the Wilson County Soil Conservation District. The Soil Conservation Service will furnish the technical assistance needed for the planning and application of conservation measures and soil surveys. The Tennessee Division of Forestry, in cooperation with the U. S. Forest Service, will furnish the technical assistance needed for planning and

installing the forestry measures. The conservation measures to be installed will be within land capabilities and treatment will be in accordance with needs for sustained agricultural production on the individual farms.

The floodwater retarding structure will be installed by contract during the third project year. The total estimated installation cost of the floodwater retarding structure and mitigating measures is $744,317, of which $573,603 is P. L. 566 funds and $170,714 is Other funds. The stream channel improvement will be installed by contract during the fourth project year. The total estimated installation cost of all stream channel improvement is $142,763, of which $123,920 is P. L. 566 funds and $18,843 is Other funds.

The principal spillway of the floodwater retarding structure will be modified to include a submersed inlet and vertical slide gate to mitigate downstream losses in fish production. The cost of installing these measures is estimated to be $1,356 and will be financed from P. L. 566 funds.

The Wilson Spring Creek Watershed District will assume the responsibility for installing, operating and maintaining all structural measures for flood prevention and will obtain all land rights, contract for the construction of structural measures and be responsible for all costs in acquiring the needed land, easements, and rights-of-way for the installation of structural measures. The District will administer all contracts, and will also be responsible for all other costs, such as, additional organizational costs, assessor fees, legal fees, and other administrative costs.

The Wilson Spring Creek Watershed District has initiated negotiations with the Farmers Home Administration to finance its share of the project installation costs by utilizing the loan provisions of Section 8, P. L. 566, as amended. The loan will be repaid by the District through an annual assessment which is in accordance with the provisions of the Tennessee Watershed District Act of 1955, as amended.

It is estimated that 3,490 acres of flood plain land will be directly benefited by the proposed structural program. No monetary benefits are claimed on 314 acres of the above flood plain which is downstream from U. S. Highway 231. The average annual benefits used in project justification of structural measures are estimated to be $60,006. The floodwater retarding structure and 305,000 feet of stream channel improvement for flood prevention and mitigating measures will be installed, operated and maintained at a total annual cost estimated to be $34,351, which includes $5,290 for operation and maintenance. The benefit-cost ratio is 1.7:1.0.

DESCRIPTION OF WATERSHED

The Wilson Spring Creek Watershed is located in Wilson County, Tennessee, and has a drainage area of about 40,040 acres, or 62.6 square miles. Its shape is long and narrow with a length of about 20 miles in a north-south direction and an average width of about 3.5 miles. Spring Creek, the principal stream, is a tributary of the Cumberland River (Old Hickory Reservoir); their confluence is about 37 river miles upstream from Old Hickory Dam. The basically agricultural economy is founded on soils which are derived from the limestone bedrock of the Nashville Basin.

Physical Data

The rainfall distribution during the growing season is generally adequate for crop production. At present, there are no irrigation systems nor are there any planned for this watershed. Water sources are considered adequate for water needs.

Water for domestic use is supplied from drilled wells and springs. Livestock water is obtained from farm ponds, springs and streams. There is no indication of a shortage in the ground water supply.

The mean annual precipitation is about 50 inches, with 29 inches occurring in the months of April through November. The wettest month is January with a mean of 6.01 inches and the driest month is October with a mean of 2.63 inches. The mean annual temperature is 60.0 degrees with the monthly averages of 39.9 degrees in January and 80.2 degrees in July. The average length of the growing season is 224 days, with the first and last killing frosts occurring in the months of November and April, respectively.

The physiographic location of the watershed is the Outer and Inner Central Basin. The topography, characteristic of old-age, is rolling although the local relief is greater in the Outer than the Inner Basin. The maximum relief in the watershed is 870 feet which is the difference between the highest points in the Southern Divide (1,350 feet MSL) and Spring Creek at its confluence with the Cumberland River (480 feet MSL). The difference in elevation between the ridgetops and adjacent flood plains ranges from about 300 feet in the Outer Basin to 100 feet in the Inner Basin.

The geologic formations exposed in the watershed are limestone, argillaceous limestone, arenaceous limestone, and shale of Ordovician age. The Leipers, Catheys, Bigby-Cannon, and Hermitage formations underlie the Outer Basin and the soils there have been developed in the residual material from the weathering of these formations. The Carters and Lebanon limestone underlie the Inner Basin where the Inner Basin soils and "Glade" areas have developed.

The soils developed in this watershed are divided into seven general soil groups. They are: (1) Huntington, Armour, Lindside; (2) Talbott, Colbert, Rockland, Hagerstown; (3) Etowah, Talbott, Rockland; (4) Inman,

Maury, Rockland; (5) Rockland, Inman, Armour; (6) Rockland, Talbott, Colbert; and (7) Delrose, Mimosa, Rockland.

The Huntington, Armour, Lindside soils occupy about 10 percent of the watershed and are found in the flood plain and terraces of the main stream and its tributaries. The Huntington and Armour soils are very deep to deep, well-drained, highly-productive soils and the Lindside soils are very deep, moderately drained to somewhat poorly drained, moderately productive soils. They average three to seven feet to bedrock.

The Talbott, Colbert, Rockland, Hagerstown soils occupy about 56 percent of the watershed and are found on the more level uplands of the Inner Basin with slopes ranging from 0 to 20 percent. The Talbott soils are well to moderately well-drained, deep and moderate in natural fertility with depth to bedrock ranging from three to five feet. Colbert soils are moderately well-drained, low in productivity, and are 15 to 30 inches in depth over limestone bedrock. The Rockland occurs mostly on the tops of the rolling hills with most of the area covered with limestone bedrock outcrops. There is a little soil material in cracks and crevices between the outcrops. The Hagerstown soils are located on the broad tops of the rolling hills. They are four to sometimes ten feet in depth, well-drained and moderately productive.

Of the remaining general soil groups, the Etowah, Talbott, Rockland soils occupy about eight percent of the area; the Inman, Maury, Rockland about four percent; the Rockland, Inman, Armour about ten percent; the Rockland, Talbott, Colbert about eleven percent; and the Delrose, Mimosa, Rockland about one percent. These soils are generally well-drained and shallow with depth to bedrock ranging from zero to four or five feet and occasionally ten to fifteen feet. These soils also are generally low in productivity with minor areas which are Talbott, Maury, Armour, Delrose, and Mimosa soils being moderately to highly productive.

The present land use distribution and the hydrologic cover conditions in the watershed is 13,261 acres in cropland with poor to fair cover conditions; 7,754 acres in grassland with fair cover conditions; 16,121 acres in woodland with poor to very poor cover conditions; and 2,904 acres in miscellaneous use or is idle with fair cover conditions.

Forestry

The forest land has an area of about 16,121 acres, of which 188 acres are found in the flood plain. All forest land is in private, non-industrial ownership.

The forest types are hardwoods (68 percent) and red cedar (32 percent). Major species are red cedar, elms, hickories, green ash, hackberry, black walnut, and honey and black locusts. The existing stands are mostly made up of seedlings and saplings. Fifty percent has poor merchantable stocking.

Most of the forest land is in poor to very poor hydrologic condition. This is due to grazing and logging damage and to the shallow to very

shallow soils on most of the upland forest area. The Rockland series predominates, and the areas of frequent outcrops have a very low potential for improvement. The associated shallow soil areas have a low rate of recovery. However, about one-third of the upland forest lies on moderately deep to deep and moderately permeable soils, mostly old alluvial and colluvial deposits. These soils can be brought to good to very good hydrologic condition with proper management and protection. On the shallow soils over limestone, good protection would produce a significant improvement in hydrologic conditions. Overland flow and sedimentation of drainage channels would be reduced and conditions for plant and tree growth would be improved.

Fish and Wildlife

Game fish found in Spring Creek are largemouth bass, smallmouth bass, rock bass and other sunfish. Other species present are suckers, carpsuckers, and catfish. Fish production in the stream is provided by a system of pools and riffles, wet and dry cover consisting of trees, stumps, gravel bars, rocks, and rock ledges, and periodical overbank flooding. Although the stream does not flow year-round, the deeper holes remain as effective fish habitat throughout the year.

There are a few resident wood ducks in the area. Use of the watershed by migrant waterfowl is negligible except during the fall and winter months when flooded fields provide good feed and feeding conditions. Other important wildlife species in the watershed area are rabbit, squirrel, quail and dove. The population of each of these species is moderate in extent with hunting pressure, high on rabbit and quail, moderate on dove and low on squirrel.

Economic Data

The agricultural economy of the watershed is largely dependent upon the raising of livestock, growing of cultivated crops and harvesting forestry products. Transportation and marketing facilities are adequate, with the area being served by a network of State and County roads.

The present land use distribution is 13,261 acres in cropland, 7,754 acres in grassland, 16,121 acres in woodland, and 2,904 acres in miscellaneous use or is idle. About 80 percent of the cropland is in or adjacent to the flood plain. The flood plain is the most fertile and productive land to be found within the watershed, and is important to the overall agricultural economy. The average net income per farm is low because of physical characteristics of the uplands and low intensity use of the flood plain due to flood damage.

According to the latest available County Agricultural census (1959), the average value of farm products sold per farm in Wilson County is about $2,800. It is estimated that the value of farm products sold per farm in the Wilson Spring Creek Watershed is less than $2,000 on at least 50 percent of the farms. The 10-year average (1954-63) value of farm products sold per farm in Tennessee is about $3,300.

The number and quality of livestock on nearly every farm has increased greatly in recent years. The chief source of gross income from marketing is livestock and livestock products. It is estimated that 50 percent of the income from livestock is dairy, 35 percent beef cattle, 12 percent sheep and three percent hogs. The principal crops grown are tobacco, corn, silage, barley, hay and pasture. The leading source of cash receipts from marketing crops is tobacco. The principal row crop grown in terms of acreage is corn, of which about 25 percent is harvested as silage. At present, about 25 percent of the needed feed grains are being supplied by local production. Feed grains and forage crops produced in the watershed are used on the farm to help support the livestock program.

There are about 500 families, or 2,200 people, living on 400 farms. These farms are owner-operated with about 60 percent full-time farmers, 20 percent part-time, and 20 percent that have full-time off-farm employment. The farms range in size from 35 acres to 800 acres, with 10 percent being over 300 acres. It is estimated that the average size of farms is about 150 acres and the value, including fixed improvements, is $40,000.

In addition, there are about 80 non-farm families, or 300 people, residing on tracts of ten acres or less. These families receive the larger portion of their living from off-farm employment at nearby Lebanon and Nashville.

The cities of Lebanon and Nashville are the chief trade centers and work areas for off-farm employment. About 50 percent of the farm products are sold locally, and 50 percent transported to Nashville and other nearby markets. It is estimated that 500,000 people live within a 30-mile radius of the watershed.

A network of Federal, State and County roads provide easy access to nearby markets and business areas. Federal and State Highways, including Interstate I-40, cross the watershed at six locations. Numerous paved and graveled County roads provide access to the remaining area.

The entire watershed is under the Wilson County Soil Conservation District Program organized in 1943. There are 121 farms, or 19,250 acres, which have basic soil and water conservation plans and 42 other farms, or 4,260 acres, which have received assistance from the District. These farms represent about 60 percent of the watershed area. In the ten-year period from 1954-63, conservation measures were applied in the watershed with District assistance at a total estimated cost of $518,679. (See Table 1A, page 23). There has been some improvement work of a minor nature done on Spring Creek and its tributaries, but it has not had a lasting effect on relieving the overall flood problem.

Wilson County has been under fire protection since 1962. With continuing prevention work, the organization seems capable of adequate protection for the watershed area. Woodland grazing is a problem in watershed management.

Forest fire prevention and suppression, forest management assistance, insect and disease control and cooperative reforestation are provided private landowners by the Tennessee Division of Forestry in cooperation with the U. S. Forest Service. These services are available through the various Federal-State Cooperative forestry programs.

About five percent of the needed forestry practices have been applied to the 16,121 acres of forest land. Approximately 34 percent of the upland forest land needs treatment for watershed management purposes.

WATERSHED PROBLEMS

The primary problem of the watershed is flood damage to crops and pasture, fences, roads and bridges, rural property, other minor fixed improvements, and flood plain scour. The total average annual flood damage under present conditions is estimated to be $37,043, Table 5, page 28. The average annual flood damage to crop and pasture values is $12,387; road and bridges, $8,250; other agricultural, $6,328; flood plain scour, $5,673; and indirect, $4,405. The present average value of the 4,187 acres of flood plain land ranges from $250 to $300 per acre.

Floodwater Damage

The largest storm in the evaluation period occurred March 16, 1963, and produced 3.04 inches of rain in 14 hours. This storm had an estimated 2.71 inches of runoff which inundated 4,187 acres of land. Some portions of the main flood plain begin flooding following rainfall of about 1.35 inches within a 24-hour period.

Eighty damaging flood events were evaluated during the 20-year period from January 1944 through December 1963. Damaging floods to crops and pastures occurred in every month of the cropping period of April through November. The largest number of flood events during this period came in the months of April, May, June and September. The larger floods, which occur about once in three years, cause almost complete crop loss.

Frequent spring floods during April and May delay land preparation and planting on flood plain lands. Floods that occur after normal planting time make it necessary to prepare a new seedbed before replanting. This often results in broken, uneven stands, increased cost of production, and greatly reduced yields. About 50 percent of the floods during the cropping season occur during the critical months of April, May and June. Farmers report having to replant as many as two to three times a season due to flooding. This necessitates having to use a short-season variety crop that normally produces lower yields.

The major portion of 240 acres of tobacco, corn and alfalfa hay now grown on the uplands is the result of the present high risk of flooding and increased cost of production in the flood plain. The flood hazard has caused some areas of upland, unsuited for row crops, to

be retained in cultivation.

The flood damage to scattered rural property occurs about once every four to six years. The largest storm in the evaluation series caused some damage to a church building, four rural homes, eight barns and other farm buildings. The losses to rural property consist of floodwater and sediment damage to buildings, their contents, outside improvements, and inconvenience to local residents.

Damage to roads within the flood plain consists of scouring of the shoulders, silting of road drainage ditches, washing away of segments of earth fill, washing off surface gravel, the breaking of asphalt paving and the erosion of portions of the roadbed and fill beneath the pavement. The damage to bridges and box culverts ranged from damage to abutments and approaches to the complete loss of the bridge.

Other agricultural damage within the flooded area consists of livestock losses; damage to fences, water gates and farm bridges; and damage to drainage systems by the accumulation of debris. The cost of repairing this damage is often as expensive as that of replacement.

Sediment Damage

Sediment production is moderate in this watershed but has caused some channel fill which was evaluated with floodwater damages. Channel fill has increased the frequency of flooding in the affected areas. Sediment damages are minor on flood plain land and were not evaluated monetarily. There are no critical sediment producing areas in the watershed.

Erosion Damage

The continued cultivation of row crops on rolling and steep upland soils and the lack of adequate cover have contributed to the loss of top soil. The effect from the loss of top soil has reduced yields per acre and soil deterioration is occurring. Much of this open land has been subjected to moderate sheet erosion. The average rate of gross erosion is five tons per acre per year on the upland portion of this watershed.

The damage in the flood plain is caused by scouring or erosion during periods of overbank flow. The width and depth of the scour channels and the severity of the damage is related to the depth, velocity, duration, and type and amount of ground cover at the time of flood flow. The effect of these scour channels has reduced the productive capacity of 650 acres of flood plain about 30 percent.

Indirect Damage

Indirect damages in the watershed are associated with the agricultural and non-agricultural damages. The losses are less obvious, but are just as real and their effects are felt long after the flood has subsided. The indirect damages that accrue are a result of the disruption of traffic, mail delivery, and school bus service; delay and

inconvenience to the traveling public; and the interruption of the management, feeding, disease control program, and marketing of livestock and livestock products.

Problems Relating to Water Management

The main and tributary stream channels have more than adequate capacities for drainage requirements but lack sufficient capacities for flood prevention.

PROJECTS OF OTHER AGENCIES

There are no soon to be constructed works of improvement (County, State or Federal) for water resource development which will affect or be affected by the works of improvement included in this plan.

The Wilson Spring Creek Watershed is located in the Cumberland River Basin. The watershed comes under the purview of the Corps of Engineers, Nashville District. This agency has been informed of the plans and progress made in the work plan development.

Old Hickory Lock and Dam, located at Cumberland River Mile 216.2, was authorized for construction by the River and Harbor Act of 1946 (Public Law 525, 79th Congress, 2d Session). The concrete and earth dam and lock were designed by the U. S. Corps of Engineers and construction started in January 1952. The project was completed for full beneficial use in December 1957. The Old Hickory project functions to produce hydro-electric power, navigation above Nashville, temporary flood control by surcharge operation, conservation by stream flow regulation and pollution abatement, and recreation.

BASIS FOR PROJECT FORMULATION

In formulating this project for flood prevention, the major consideration was the cause, amount and location of flood damage in the flood plain. The nature of these damages was discussed with the local sponsoring organization so there would be a common understanding of the type and degree of protection that might be expected from any control program installed in the watershed.

Project formulation was based on the objectives agreed upon with the sponsoring local organization. These objectives are: (1) a significant improvement in establishing soil and water conservation measures; (2) a reduction in flooding on two-thirds of the flood plain so that the production of cultivated row crops, hay or pasture, in rotation, can be managed more intensively at least two years out of three; (3) flood damage to roads and bridges, rural property and minor fixed improvements be reduced to a minimum; and (4) to maintain the present fishery resources in Spring Creek.

Land treatment measures are considered one of the basic elements in formulating a watershed project and are essential if it is to function successfully. Land treatment measures included in this plan were selected

on the basis that they will: (1) be effective in reducing erosion damage on existing cropland; (2) reduce runoff and sediment production that would adversely affect operation, maintenance, and the useful life of the proposed works of improvement; (3) be necessary to assure the realization of benefits used in justification of structural measures for flood prevention; and (4) increase the efficiency of land use on existing farms.

The selection of the structural works of improvement was guided by the objectives of the Sponsoring Local Organization, physical characteristics of the watershed, and appropriate engineering criteria. The presence of bedrock limits the stream channel improvement that can be accomplished economically and places the burden of meeting the desired level of protection on floodwater retardation.

Five physically adapted sites for floodwater retarding structures were selected for evaluation. These sites were located on Lateral "1", Lateral "2", Upper Spring Creek, West Fork Spring Creek, and Dedman Branch. The presence of limestone bedrock indicated costly foundation treatment and increased cost for other appurtenances associated with the floodwater retarding structures, such as, emergency spillways. It soon became apparent that these five floodwater retarding structures, with their high construction costs, would not be economically feasible. Two additional sites were then selected on main Spring Creek at Valley Sections 12 and 13. These two structures were analyzed separately in search for a program that would be economically feasible and provide an acceptable level of protection. The one floodwater retarding structure proposed in this plan provides an acceptable level of protection at the least cost. Stream channel improvement (clearing and snagging) will supplement the land treatment and structure program in providing protection to meet the project objectives.

The selection of measures that would effectively mitigate the damage to fish and wildlife was made after a careful study of the extent and composition of the present fish and wildlife resources within the watershed and the effect on these resources by the proposed structural measures for flood prevention. Mitigation for waterfowl was not found necessary. Several proposals were considered for fish management, but only two were found to be practical and adequate. These measures are: (1) to modify the principal spillway to include a submersed inlet for removing the normal overflow from near the bottom of the reservoir, and (2) the installation of a vertical slide gate within the submersed inlet, three feet below the surface of the permanent pool.

A preliminary design with cost estimates for a recreational development with minimum basic facilities was made at the proposed floodwater retarding structure site. After careful consideration of the possibility of leakage through bedding planes, joints, and solution openings in the bedrock, the Sponsoring Local Organization felt that they could not undertake the risk and financial obligations of installing, operating and maintaining this recreational development.

WORKS OF IMPROVEMENT TO BE INSTALLED

The planned works of improvement to be installed are, (1) the application of needed conservation measures on 8,300 acres of land for watershed

protection, (2) the installation of one floodwater retarding structure and the improvement of 305,000 feet of stream channel for flood prevention, and (3) the installation of mitigating measures that temper or reduce damages to fish habitat. Kinds of measures, quantities, and distribution of installation costs between P. L. 566 funds and Other funds for the total project are shown on table 1, page 22.

Land Treatment Measures

The land treatment measures to be installed on 8,300 acres for watershed protection will have a measurable physical effect on the watershed and were acceptable to the Local Sponsoring Organization. These measures will improve the hydrologic condition, decrease runoff, erosion and sediment production, and assure the realization of benefits used in project justification.

The application of conservation measures on 4,250 acres of cropland will consist of conservation cropping system, contour farming, contour stripcropping, gradient terraces, grassed waterways, diversions, cover and green manure crops, and drainage field ditches. The treatment of 2,840 acres of grassland will consist of the establishment of grassed waterways, permanent hayland, and pasture planting and the renovation of pasture and hayland. The improvement of 1,150 acres of woodland will consist of tree planting and hydrologic stand improvement. The construction of farm ponds and wildlife habitat development will be on 60 acres of miscellaneous land. The land treatment measures for watershed protection will be installed at an estimated total cost of $296,628.

The practice of general farming prevails and the trend is increased rotation of crops in order to maintain fertility and produce an ample supply of forage and grain for livestock feed. The basic concept in the rotation is a cultivated crop, followed by small grain and then grasses or legume-grass mixture. The land treatment measures to be installed will vary with the land use, economic conditions, acreage controls, customs, trends, conservation needs, and flood reduction.

The land treatment measures on forest land will reduce soil erosion, sediment production, and storm runoff and will aid in the recharge of ground water for plant and tree growth. The forest litter produced under proper management protects the soil and is the source of humus needed for increased infiltration and water storage. About 1,010 acres of forest land will be treated for hydrologic stand improvement and 140 acres of depleted, poorly protected open land will be planted to forest trees. Hydrologic stand improvement will be achieved with such measures as interplanting, underplanting with release, release of preferred tree species, improvement cuts and grazing control.

The conservation measures to be installed will be within land capabilities, and treatment will be in accordance with needs for sustained agricultural production on the individual farms. Alternative measures and land use will be in keeping with standard criteria established and used in soil and water conservation. Alternative measures that are necessary and justifiable for the conservation, development, protection and improvement of the individual farms may be installed.

Structural Measures

One floodwater retarding structure for the control of damaging water flow and sediment is planned for a location as shown on the Watershed Project Map, page 37. The structure includes an earth dam with a fixed drawdown tube of concrete pipe and an emergency spillway excavated in rock. A reinforced concrete riser will establish the elevation of the sediment pool. A metal slide headgate, located near the bottom of the riser, will permit drainage of the sediment pool. It will also permit the necessary fluctuation of the water level for the control of obnoxious vegetation and mosquitoes. All embankments, borrow areas, and other areas disturbed in construction will be stabilized with suitable vegetation.

Design data for the structure is shown on table 3, page 25. A section of a typical floodwater retarding structure is shown on page 36.

The floodwater retarding structure will store the expected 100-year sediment accumulation, will provide 4,986 acre-feet of floodwater detention, and control about 25.5 percent of the watershed area. This floodwater detention capacity is the equivalent of 5.58 inches of runoff from the area above the structure and 1.42 inches from the total watershed area.

The total estimated cost of installing the floodwater retarding structure and mitigating measures is $744,317, table 2, page 24, and the annual cost, including operation and maintenance of $1,305, is $25,689.

Channel improvement will be installed on approximately 305,000 feet of stream channels. This improvement will consist of 115,100 feet on Spring Creek, 23,420 feet on Shop Springs Branch, 11,290 feet on Dedman Branch, 9,340 feet on Black Branch, 8,800 feet on Lateral "1", 6,500 feet on Lateral "2", 72,850 feet above the floodwater retarding structure, and 57,700 feet on twenty minor tributaries. The improvement of twenty minor tributaries will provide an outlet for floodwater from adjacent hill land across the flood plain into Spring Creek.

The main channels were designed to accommodate the peak flow for the 6-hour annual storm. Design data, channel capacity, and other pertinent information on channel improvement is shown on table 3A, page 26.

All channel improvement will be clearing and snagging and will include spreading or removal of gravel and sand bars, removal of drifts, brush, and trees within the wetted perimeter. The larger trees located along the top of the channels will not be disturbed. This growth should add to the stability of the channel banks and the resulting shade can reduce channel maintenance by retarding small vegetative growth. The larger trees will also provide food and cover for wildlife.

The location of the planned channel improvement will generally be limited to that as shown on the Project Map. Existing bridges and culverts are adequate to provide the planned capacities.

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No modification will be necessary to the natural gas transmission line that crosses Spring Creek approximately 3,200 feet above U. S. Highway 231.

Total estimated installation cost for all channel improvement is $142,763, Table 2, and the annual cost, including operation and maintenance of $3,985, is $8,662.

Mitigating measures will be installed to temper or reduce damage to fish habitat. The principal spillway of the floodwater retarding structure will be modified to include a submersed inlet. This inlet will be an appurtenance to the principal spillway and consists of a vented tube that extends from slightly above the surface of the sediment pool to a predetermined depth. This modification will take the normal base stream flow from below the surface of the permanent pool, thus removing the stagnant or low-oxygen water that develops in the bottom waters. For the submersed inlet to be effective, the bottom of the inlet will be located one to two feet above the normal valley floor. One foot should be used when the present ditch or stream bottom is more than three feet below the valley floor and two feet when the stream is less than three feet below the valley floor.

A vertical slide gate will be installed in the riser of the principal spillway within the submersed inlet. The bottom of the gate will be located three feet below the surface of the sediment pool. At this depth, the surface area of the permanent pool will be decreased by 50 percent. The gate will be of a sufficient size to lower the water level within 10 days or less. The purpose of this gate is to enable the water level of the sediment pool to be effectively lowered for fish population management.

Where consistent with sound engineering practice in design and construction, trees, stumps, gravel bars and rocks, presently providing cover and shade for the protection and propagation of fish will be retained during the clearing and snagging operations for stream channel improvement.

The total estimated installation cost of all mitigating measures is $1,356, and the annual cost, including operation and maintenance of $50, is $94.

EXPLANATION OF INSTALLATION COSTS

The total estimated installation cost of the project is $1,183,708, of which $733,523, or 62 percent, will be P. L. 566 funds and $450,185, or 38 percent, will be Other funds. The schedule for estimated installation cost by project years is shown on page 15.

The total estimated installation cost for all land treatment measures is $296,628; $36,000 from P. L. 566 funds, and $260,628 from Other funds. These estimated installation costs include labor, materials, machinery, and all direct and indirect costs related to these measures.

The total estimated installation cost of land treatment, except forestry measures, is $269,128; $237,128 will be Other funds and $32,000 will be P. L. 566 funds for accelerated technical assistance. The funds for technical assistance will be $17,826 from P. L. 566 and $10,112 from the going conservation program for the preparation and application of basic farm conservation plans, and $14,174 from P. L. 566 and $288 from the going conservation program for soil surveys.

Land treatment measures recommended for forest lands will cost approximately $27,500. This includes $7,200 for technical assistance and $20,300 for measure installation. An estimated cost of $500 for operation of the going Cooperative Forest Management Program is included in the technical assistance cost. This represents costs during the four-year installation period of the watershed program. The cost of the going Cooperative Forest Management Program which is included in the Other funds column in table 1, is made up of matching State and Federal funds. Estimated costs of the recommended program are based on the costs of similar treatments in 1964.

The total estimated installation cost of the one floodwater retarding structure and mitigating measures is $744,317. The cost to be borne by P. L. 566 funds for construction, engineering services, and other (administrative, etc.) is $573,603. The estimated construction cost is $468,384, which includes $62,700 for foundation treatment and $50,184 for contingencies. The estimated cost of installation services needed to install the structure is $105,219. The total installation cost to be borne by Other funds is estimated to be $170,714. The estimated cost of land rights--land, easements, and rights-of-way--is $165,450, administering contracts, $300; and other costs, $4,964. Also included in the estimated land rights costs is an allowance of $25,750 for raising roads and $24,500 for fixed improvements. The other costs are for additional organization costs, assessor fees, legal fees, or general administrative costs which are incurred in connection with obtaining the above land rights, or costs incurred as an obligation of the Wilson Spring Creek Watershed District.

The total estimated cost of $1,356 for installing the mitigating measures will be borne by P. L. 566 funds for construction, engineering services and other (administrative, etc.).

The total estimated installation cost of the 305,000 feet of stream channel improvement is $142,763. The cost to be borne by P. L. 566 funds for construction, engineering services, and other (administrative, etc.) is $123,920. The estimated construction cost is $105,336, which includes $11,286 for contengencies. The estimated installation services needed to install the stream channel improvement is $18,584. The total estimated installation cost to be borne by Other funds for the stream channel improvement is $18,843. The cost of land, easements and rights-of-way is $18,100, administering contracts, $200, and other costs, $543.

SCHEDULE OF ESTIMATED INSTALLATION COSTS

Project Year (1)	Estimated Cost (Dollars): Non-Federal Land, P. L. 566 (2)	Non-Federal Land, Other Funds (3)	Total (4)
First	9,089	93,407	102,496
Second	70,609	232,560	303,169
Third	539,198	95,915	635,113
Fourth	114,627	28,303	142,930
TOTAL	733,523	450,185	1,183,708

EFFECTS OF WORKS OF IMPROVEMENT

It is estimated that 3,490 acres of flood plain land will be directly benefited by the proposed structural program. No monetary benefits are claimed on 314 acres of the above flood plain which is downstream from U. S. Highway 231. The current average market value of the flood plain land is estimated to be increased by $250 to $300 per acre. The net returns per acre on the benefited area will be increased and the overall economy of the entire community will be enhanced.

Flooding during the cropping season of April through November will be less frequent than once in three years on 70 percent of the 3,176 acres of flood plain land on which benefits are claimed. The area inundated by the maximum storm in the evaluation period will be reduced by 17 percent, and flooding during the entire year will be less frequent than once in three years on 42 percent of the flood plain benefited by structural measures.

It is estimated that crop and pasture damage will be reduced by 67 percent; road and bridge, 67 percent; other agricultural, 62 percent; flood plain scour, 62 percent; indirect, 65 percent; and the sediment yield, 25 percent.

The reduction in overbank flooding will reduce the annual scouring of the fertile flood plain lands and allow reclamation and more intensive use of these scoured or potential scour areas. The average annual damage attributed to scour will be reduced by 62 percent. It is estimated that 72 acres can be restored to former productive use and 2,818 acres of flood plain can be used more intensively for the production of tobacco, corn, silage, barley, hay and pasture, in rotation. The farmers indicate their need for the higher quality forage and grain crops for livestock which is the chief source of farm income. Increased yields can be expected due to better management practices and improved technology made possible with the project installed.

The frequency, duration and magnitude of flood damage has resulted in some upland areas, that are more suited to permanent grass, being used for the production of cultivated crops. With the project installed, the

benefited lands can be more intensively used for the production of cultivated row crops and higher quality forage crops which will permit needed land use adjustments to be made on the uplands. The future land use in the watershed is anticipated to be 11,433 acres cropland, 16,213 acres woodland, 9,605 acres grassland, and 2,789 acres miscellaneous use. Estimates indicate that there will be no increase in the total acreage of allotted crops within the watershed.

The local secondary benefits stemming from or induced by this project are considered pertinent to the economic evaluation. These secondary benefits will accrue as a result of increases in the sale of agricultural products and increased income to local processors, business establishments, and other individuals not directly benefited. These local secondary benefits are also considered to include the transporting, processing and marketing of those goods and services that produce the primary benefits and the supply of additional materials and services required to make possible the increased net returns which stem from the installation of the project.

The reservoir created by the sediment pool in the floodwater retarding structure will provide incidental water related recreation by organized groups or the general public. These facilities will be available to the 2,500 residents of the watershed as well as 500,000 additional residents within a 30-mile radius. It is estimated that incidental recreation will amount to 12,240 user-days annually. The Wilson Spring Creek Watershed District will provide access to the partially developed recreational facilities. The inclusion of a special provision in the easements granted or purchased will define and assure this access.

The proposed forest land treatment measures will reduce erosion and sedimentation, retard storm runoff, and improve the productivity of forest land.

The objectives of the individual farmers are to develop a long-range plan which will give the highest net income, based on appraisal of production alternatives that will provide the most productive use of his resources of land, labor, capital, and management. The application of conservation measures will provide more adequate cover, improve infiltration and physical conditions of the soil, contribute to the control of excessive runoff, reduce sheet erosion, increase yields per acre, and aid in maintaining the effectiveness of group facilities for watershed protection and flood prevention.

It is estimated that the value of farm products sold on 50 percent of the farms is below $2,500 per farm. Redevelopment benefits will accrue from the installation of the proposed project and will provide employment for unemployed or under-employed local labor. Accelerated technical and financial assistance provided as a result of the installation of this project will improve the standard of living in the low-income area, and enhance the overall economy of the entire community.

The installation of the floodwater retarding structure and stream channel alterations will reduce the flooding of land adjacent to Spring Creek.

This decrease in flooding will reduce the amount of flood and feeding area and thus reduce total fish production. Channel alterations such as clearing, snagging, bar and debris removal, etc., will also destroy fish habitat in the stream channel.

Installation of the floodwater retarding structure will create a 72-acre body of water which will provide increased fishing waters in the watershed. It is also anticipated that a plunge pool with excellent fishing opportunities will be created by the principal spillway discharge immediately below the outlet end of the principal spillway. The installation of the submersed inlet and vertical slide gate on the principal spillway will allow proper management of the floodwater retarding structure for fish production by allowing the sediment pool to be drawn down three feet, when necessary, to mitigate the damage to fish habitat caused by channel alterations. These facilities will also be used in maintenance of the structure by aiding in the control of aquatic vegetation.

PROJECT BENEFITS

The average annual benefits used in justification of the floodwater retarding structure and stream channel improvement are estimated to be $60,006, table 6, page 29.

The average annual flood damage without the project is estimated to be $37,043, and the estimated benefits from flood damage reduction are $24,222, table 5, page 28. These benefits consist of reduction in crop and pasture damage amounting to $8,321, which includes $2,067 from restoration to former productivity; other agricultural, $3,922; road and bridge, $5,550; flood plain scour, $3,545; and indirect, $2,884.

The estimated more intensive land use benefits of $23,488 will accrue as a result of flood prevention. These benefits are estimated on the basis of the difference in net returns with and without the project, and consideration was given to farmer participation, the capability of the soils and their potential productivity.

The value of local secondary benefits amounts to $6,425, those stemming from the project are estimated to be $4,483, and those induced by the project are estimated to be $1,942. The value of secondary benefits from a national viewpoint were not considered pertinent in the economic evaluation or justification of this project. Incidental recreation benefits are estimated at $6,120. The economic impact of project installation is considered pertinent but redevelopment benefits were not evaluated or used in project justification.

Research and experience has demonstrated that the combined private and public benefits derived from land treatment measures will exceed their cost of installation. The physical effects of land treatment measures included in this plan were estimated but no specific determinations of monetary benefits from the installation were made for their economic justification. The annual benefits accruing as a result of the installation of land treatment measures for watershed protection or flood

prevention were not used in the economic justification of structural measures.

COMPARISON OF BENEFITS AND COSTS

The installation of one floodwater retarding structure and 305,000 feet of stream channel improvement for flood prevention will be installed, operated and maintained at a total average annual cost estimated to be \$34,351. The average annual benefits used in project justification are estimated to be \$60,006, which include local secondary benefits of \$6,425 accruing within the zone of influence of the project. The benefit-cost ratio accruing as a result of project installation from both primary and secondary monetary benefits is 1.7 to 1.0, and from primary benefits is 1.6 to 1.0.

PROJECT INSTALLATION

The sponsors of the Wilson Spring Creek Watershed District desire that the land treatment and structural measures be installed during a four-year period.

The land treatment measures for watershed protection will be planned and applied, farm by farm, in cooperation with the going and accelerated program of the Wilson County Soil Conservation District.

The Soil Conservation Service will accelerate their technical assistance to the going District Conservation Program from P. L. 566 funds. The technical assistance will be for the preparation and application of basic soil and water conservation farm plans and soil surveys. During the installation period, about 37,918 acres of land in the watershed will be mapped according to the standard soil survey. Technical assistance will be provided to all the landowners in the watershed to accelerate the establishment of needed soil and water conservation measures.

The sponsors of the watershed project will encourage forest landowners to apply and maintain the forestry measures needed for good watershed management. Trained personnel of the Tennessee Division of Forestry will advise and assist the sponsors in this matter.

The technical assistance now provided by the going Cooperative Forest Management Program will continue during the installation period. The Tennessee Division of Forestry, in cooperation with the U. S. Forest Service, will provide additional technical assistance to accelerate forest land treatment during the installation of the watershed project. The forester assigned to this project will be trained in watershed management and will assist the landowners in planning and installing the forestry measures for the project.

The Wilson Spring Creek Watershed District has sufficient legal authority--including raising of funds through taxation or assessments and the power of eminent domain--to acquire all land, easements and rights-of-way needed for the project. This authority will be used as needed for the orderly

progress in installing the planned works of improvement. The Wilson Spring Creek Watershed District will obtain all land rights, contract for the construction of the structural measures, and be responsible for all costs in acquiring the needed land, easements and rights-of-way, administering contracts, and other costs, such as, additional organizational, assessor, legal, court hearing and other administrative.

Technical assistance will be provided by the Soil Conservation Service to assist in design, preparation of specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of planned works.

The Wilson County Soil Conservation District will obtain agreements from farm owners and operators to carry out recommended soil and water conservation measures on not less than 50 percent of the land situated in the drainage area above the floodwater retarding structure. These agreements will be obtained prior to any P. L. 566 funds being provided for the construction of the structure.

The floodwater retarding structure will be built during the third project year. The stream channel improvement is contingent upon the floodwater retarding structure and is scheduled to be done the fourth project year. The stream channel improvement is scheduled to begin at the lowest point needed downstream and move upstream.

The roads within the pool area of the floodwater retarding structure will be raised as agreed upon by the Sponsoring Local Organization, the local branch of government responsible for the roads and the Soil Conservation Service. The Sponsoring Local Organization will be responsible for disposition of these roads.

The sediment pool of the floodwater retarding structure will be correctly stocked with fingerling fish from Federal hatcheries, and technical assistance will be provided by the Soil Conservation Service in stocking and managing this pool for fish production.

FINANCING PROJECT INSTALLATION

The Wilson Spring Creek Watershed District was authorized by referendum on August 20, 1960, and was formed in accordance with the provisions of the Tennessee Watershed District Act of 1955, as amended. The Wilson Spring Creek Watershed District has completed its formal organization and has actively participated in the development of this proposed watershed work plan. The major costs of organizing have already been incurred and were locally financed. The District will also bear all costs of court hearings, assessor fees, and other related administrative costs. This will permit operation under the Tennessee Watershed District Act of 1955, as amended.

The land treatment measures for watershed protection will be installed by the landowners and operators at their own expense. Such cost-sharing

assistance as is available under the Agricultural Conservation Program or other going program will be utilized in applying these measures.

The Wilson Spring Creek Watershed District has initiated negotiations with the Farmers Home Administration by filing a letter of intent to finance its share of the project installation costs by utilizing the loan provisions of Section 8, P. L. 566, as amended. The loan will be repaid by the District through an annual assessment. The amount of the assessment will be determined so as to meet the loan repayment needs of the District and the annual operating expense. In addition, a maintenance assessment will provide the funds needed to adequately maintain the works of improvement.

Federal assistance for carrying out the works of improvement on non-Federal land, as described in this work plan, will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended. This assistance is contingent on the appropriation of funds for this purpose and the sponsoring local organization meeting their necessary prior obligations.

PROVISIONS FOR OPERATION AND MAINTENANCE

The land treatment measures for watershed protection will be operated and maintained by landowners and operators at their own expense in cooperation with the Wilson County Soil Conservation District.

The forest land treatment measures will be maintained by landowners and operators of the farms on which the measures are applied under agreement with the sponsoring Soil Conservation District. Forestry technical assistance to operate and maintain the watershed forestry measures will be provided by the going Cooperative Forest Management Program. The needed forest fire protection will be continued by the going Cooperative Forest Fire Control Program.

The Wilson Spring Creek Watershed District will be responsible for adequately protecting, operating, and maintaining the floodwater retarding structure, stream channel improvement, and mitigating measures estimated to cost $5,290 annually. The annual operation and maintenance cost is estimated to be $1,255 for the floodwater retarding structure; $3,985 for the stream channel; and $50 for the mitigating measures. The District will arrange with the landowners and operators for minor maintenance jobs to be done as a part of their regular farm operations, estimated to be $2,710 annually. The major maintenance jobs, estimated to cost $2,580 annually, will be accomplished by the District. The Watershed District will provide, by annual assessment under the authority of the Tennessee Watershed District Act of 1955, as amended, whatever amount is needed for adequate maintenance.

The maintenance of the improved stream channel will include the removal of drifts and sediment bars and the controlling of obnoxious vegetative growth. The maintenance of the floodwater retarding structure will

include removal of debris from principal spillway, keeping adequate vegetation on dam and emergency spillway, and the repair of any damage resulting from flood events. The floodwater retarding structure will be maintained in accordance with regulations of the Tennessee State Department of Public Health.

The Wilson Spring Creek Watershed District will assume the responsibility to operate and maintain the mitigating measures which consist of a submersed inlet and a vertical slide gate in the principal spillway of the floodwater retarding structure. Maintenance will consist of the removal of debris and maintaining the vertical sliding gate in good working condition. Operation of the vertical sliding gate will consist of opening the gate during late June or July so as to decrease the surface area by 50 percent. This level will be maintained until fall. The gate will then be closed and the water level returned to its normal elevation. This drawdown for fish management will be done when the fish population needs correcting and upon the advice of a representative of the Soil Conservation Service. This operation is normally estimated to be necessary once every four to five years.

The Wilson Spring Creek Watershed District will make periodic inspections as needed and at least annually to determine the condition of the structural measures and any remedial treatment needed. A record of the inspections and maintenance operations will be kept on file and will be available for use by representatives of the Soil Conservation Service. The Soil Conservation Service will participate in these inspections at least annually and will furnish only technical guidance or other information necessary for operation and maintenance.

The Wilson Spring Creek Watershed District will execute specific maintenance agreements prior to the issuance of invitations to bid on construction of any structural measure.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Wilson Spring Creek Watershed, Tennessee

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/		
		Non-Fed Land	P. L. 566 Funds	Other Funds	Total
			Non-Fed Land	Non-Fed Land	
(1)	(2)	(3)	(4)	(5)	(6)
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	4,250	0	81,628	81,628
Grassland	Acre	2,840	0	121,700	121,700
Miscellaneous Land	Acre	60	0	23,400	23,400
Technical Assistance	xxxx		32,000	10,400	42,400
SCS - Subtotal		7,150	32,000	237,128	269,128
Forest Service					
Woodland	Acre	1,150	0	20,300	20,300
Technical Assistance	xxxx		4,000	3,200	7,200
FS - Subtotal		1,150	4,000	23,500	27,500
TOTAL - LAND TREATMENT		8,300	36,000	260,628	296,628
STRUCTURAL MEASURES					
Soil Conservation Service					
Construction					
Floodwater Retarding Structures	No.	1	468,384	0	468,384
Stream Channel Improvement	Feet	305,000	105,336	0	105,336
SCS - Subtotal			573,720	0	573,720
Subtotal - Construction			573,720	0	573,720
Installation Services					
Soil Conservation Service					
Engineering Services	xxxx		72,135	0	72,135
Adm. & Misc.	xxxx		51,668	0	51,668
SCS - Subtotal			123,803	0	123,803
Subtotal - Installation Services			123,803	0	123,803
Other Costs					
Land, Easements & R/W	xxxx		0	183,550	183,550
Admin: Contracts & Other	xxxx		0	6,007	6,007
Subtotal - Other Costs			0	189,557	189,557
TOTAL - STRUCTURAL MEASURES			697,523	189,557	887,080
TOTAL PROJECT			733,523	450,185	1,183,708
SUMMARY					
Total - SCS			729,523	426,685	1,156,208
Total - FS			4,000	23,500	27,500
TOTAL PROJECT			733,523	450,185	1,183,708

1/ Price base - 1964.

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Wilson Spring Creek Watershed, Tennessee

Measures (1)	Unit (2)	Units Applied To Date (3)	Total Estimated Cost (Dollars) 1/ (4)
LAND TREATMENT			
Conservation Cropping System	Acre	4,525	54,300
Contour Farming	Acre	1,169	7,014
Cover & Green Manure Crops	Acre	3,264	81,600
Diversions	Feet	37,000	5,920
Drainage ("V" Ditch)	Feet	10,000	1,200
Grassed Waterways	Acre	420	50,400
Farm Ponds	Number	250	57,500
Hayland Planting	Acre	1,359	53,575
Hydrologic Stand Improvement	Acre	150	1,500
Pasture Planting	Acre	3,450	155,250
Pasture & Hayland Renovation	Acre	925	37,000
Stripcropping System	Acre	100	2,000
Stream Channel Improvement	Feet	35,000	8,750
Terraces, Gradient	Feet	11,000	1,320
Tree Planting (Open Land)	Acre	50	950
Wildlife Habitat Development	Acre	20	400
TOTAL - LAND TREATMENT MEASURES			518,679

1/ Price base - 1964.

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Wilson Spring Creek Watershed, Tennessee
(Dollars) 1/

Structure Site No. or Name (1)	Installation Cost - P. L. 566 Funds				Installation Cost - Other Funds			TOTAL INSTAL. COST (9)
	Construction (2)	Instal. Serv.		Total P. L. 566 Funds (5)	Admin: Contracts & Other (6)	Land, Easements & R/W (7)	Total Other Funds (8)	
		Engineering (3)	Adm. & Misc. (4)					
Floodwater Retarding Structure 2	468,384	62,730	42,489	573,603 4/	5,264	165,450 3/	170,714	744,317
Stream Channel Improvement Clearing & Snagging	105,336	9,405	9,179	123,920	743	18,100	18,843	142,763
GRAND TOTAL	573,720	72,135	51,668	697,523	6,007 2/	183,550	189,557	887,080

1/ Price base - 1964.

2/ Includes an allowance of $5,507 for court hearing costs, assessor fees, and related general administrative costs of the watershed district and $500 for administering contracts.

3/ Includes $24,500 for fixed improvements and $25,750 for raising roads.

4/ Includes $1,356 for the installation of mitigating measures.

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURE
Wilson Spring Creek Watershed, Tennessee

Item (1)	Unit (2)	Structure Number 2 (3)	Total (4)
Drainage Area	Sq.mi.	16.75	16.75
Storage Capacity			
Sediment			
Submersed	Ac.ft.	220	220
Aerated	Ac.ft.	194	194
Floodwater	Ac.ft.	4,986	4,986
Total	Ac.ft.	5,400	5,400
Between High & Low Stages	Ac.ft.	-	-
Surface Area			
Sediment Pool	Ac.	72	72
Floodwater Detention Pool	Ac.	540	540
Volume of Fill	Cu.yds.	338,300	338,300
Elevation - Top of Dam	Ft/MSL	654.0	-
Maximum Height of Dam	Ft.	39	-
Emergency Spillway			
Crest Elevation	Ft/MSL	646.0	-
Bottom Width	Ft.	90	-
Type	-	Rock	-
Percent Chance of Use	-	2	-
Average Curve No.-Cond. II	-	85	-
Emergency Spillway Hydrograph			
Storm Rainfall (6-hr)	In.	7.51	-
Storm Runoff	In.	5.75	-
Velocity of Flow (Vc) 1/	Ft/Sec.	-	-
Discharge Rate 1/	c.f.s.	-	-
Max. W.S. Elevation	Ft.	-	-
Freeboard Hydrograph			
Storm Rainfall (6-hr)	In.	13.96	-
Storm Runoff	In.	12.05	-
Velocity of Flow (Vc) 2/	Ft/Sec.	12.8	-
Discharge Rate 2/	c.f.s.	6125	-
Max. W.S. Elevation	Ft/MSL	654.0	-
Principal Spillway			
Capacity - Low Stage 3/	c.f.s.	179	-
Capacity - High Stage	c.f.s.	-	-
Capacity Equivalents			
Sediment Volume	In.	0.47	-
Detention Volume	In.	5.58	-
Spillway Storage	In.	5.82	-
Class of Structure	-	"a"	-

1/ Little or no flow.
2/ Maximum during passage of hydrograph.
3/ Average discharge.

TABLE 3A - STRUCTURE DATA - CHANNELS
Wilson Spring Creek Watershed, Tennessee

Channel Designation	Station Numbers For Reaches		Total Water-shed Area	Uncon-trolled Water-shed Area	Planned Channel Capacity 1/	Average Release Rate of Structures	Design "n" Value	Clearing & Snagging
	Station	Station						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			(sq.mi)	(sq.mi)	(c.f.s)	(c.f.s)		(mi)
Spring Creek								
Centerline DS#2 to VS#15	318+90	624+20	33.20	16.45	2235	179	0.045	5.78
VS#15 to VS#19	624+20	1037+20	46.97	30.22	2800	179	0.045	7.82
VS#19 to VS#21	1037+20	1200+70	50.82	34.07	3000	179	0.045	3.10
VS#21 to VS#22	1200+70	1294+30	54.15	37.40	3988	179	0.045	1.77
VS#22 to Outlet*	1294+30	1469+90	62.25	45.50	1438	179	0.045	3.31
Shop Springs								
VS#9	0+00	234+20	3.08	3.08	480	-	0.050	4.44
Dedman Branch	33+30	146+20	2.46	2.46	631	-	0.050	2.14
Black Branch	100+00	193+40	2.15	2.15	432	-	0.050	1.78
Lateral #1	558+00	646+00	1.88	1.88	440	-	0.050	1.67
Lateral #2	745+00	810+00	1.56	1.56	249	-	0.050	1.23
20 Minor Tributaries	-	-	-	-	-	-	0.050	10.93
Tributaries Above FWRS #2	-	-	-	-	-	-	0.050	13.80

*NOTE - Spring Creek empties into the backwaters of Old Hickory Lake at or near VS#24.

1/ Planned channel capacity at lower end of reach.

TABLE 4 - ANNUAL COST

Wilson Spring Creek Watershed, Tennessee
(Dollars)

Evaluation Unit (1)	Amortization of Installation Cost 1/ (2)	Operation and Maintenance Cost 2/ (3)	Total Annual Cost (4)
Floodwater retarding structure in conjunction with related stream channel improvement	29,061	5,290	34,351
GRAND TOTAL - ANNUAL COST	29,061	5,290	34,351

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[1] The floodwater retarding structure and stream channel improvement are amortized for 100 years at three and one-eighth percent interest (0.032760), using a 1964 price base.

[2] Price base - long-term projected prices.

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Wilson Spring Creek Watershed, Tennessee
(Dollars) 1/

Item (1)	ESTIMATED AVERAGE ANNUAL BENEFITS		Damage Reduction Benefits (4)
	Without Project (2)	With Project (3)	
FLOODWATER			
Crops and Pasture	12,387	4,066	8,321
Other Agricultural	6,328	2,406	3,922
Non-Agricultural			
Road and Bridge	8,250	2,700	5,550
Subtotal - Floodwater	26,965	9,172	17,793
EROSION			
Flood Plain Scour	5,673	2,128	3,545
INDIRECT	4,405	1,521	2,884
GRAND TOTAL - FLOOD DAMAGE	37,043	12,821	24,222

1/ Price base - Long-term projected prices.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Wilson Spring Creek Watershed, Tennessee
(Dollars)

Evaluation Unit	ESTIMATED AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost	Benefit-Cost Ratio
	Flood Prevention				Total		
	Flood Damage Reduction 2/	More Intensive Land Use	Incidental Recreation	Local Secondary Benefits 3/			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Floodwater retarding structure in conjunction with related stream channel improvement	23,973	23,488	6,120	6,425	60,006	34,351	1.7:1.0
GRAND TOTAL	23,973	23,488	6,120	6,425	60,006	34,351	1.7:1.0

1/ Price base - long-term projected prices for benefits. See table 4 for costs.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $249 annually.

3/ Local secondary benefits stemming from primary benefits are $4,483 and induced by project installation, are $1,942.

INVESTIGATIONS AND ANALYSES

Engineering Surveys and Designs

The engineering field surveys on the Wilson Spring Creek Watershed consisted of establishing 30 miles of vertical control, surveying 26 valley cross-sections, and 100 channel cross-sections. Mean sea level was used as the datum for elevations. All vertical control was established with an elevation tolerance of 0.07 times the square root of the length of circuit (m) in miles.

The valley and channel cross-sections were chained and elevations recorded to the nearest 0.1 foot. These sections were located on aerial photographs and distances between sections were scaled from these photographs. Elevations of bridges, road crossings, culverts and other control points were established.

Topographic maps of the floodwater retarding structure were prepared on photographic prints as base maps. Contours were run at four-foot intervals by level and were located on the base map using a telescopic alidade and plane table.

The field survey data, profiles and cross-sections were plotted showing the present ditches and average ground elevations to give an adequate picture of valley shape for flood-routing and design computations. The topographic maps of the floodwater retarding structure sites were used to develop stage-storage and stage-area curves for design.

Design

The structure classification assigned to the floodwater retarding structure was "a" class. A structure failure could result in interruption of use of U. S. Highway 70, but any damage would be primarily to agricultural lands. Criteria approaching that of class "b" was used in order to maximize the flood protection of the downstream flood plains.

Provisions are made for storing the expected 100-year sediment accumulation in the structure. Eighty percent of the first 50-year sediment accumulation will be stored in the sediment pool; the remainder of the 100-year sediment accumulation will be stored in an aerated sediment pool and will not detract from the flood storage.

Preliminary design of the floodwater retarding structure was based on the design criteria as established in Engineering Memo SCS-27 and Engineering Memo TN-11. The cost of foundation treatment was estimated from the information furnished in the geologic report. The emergency spillway design was based on "b" class criteria, a short-cut flood-routing procedure as outlined in TR-2, and criteria as established in Engineering Memos SCS-27 and SCS-31 (Revised, dated April 2, 1959). All detention volume requirements were determined by short-cut methods described in Engineering Memo TN-11 (dated January 17, 1964).

The required peak discharges for channel design were determined by a partial duration series developed from the historical series. The annual storm runoff was obtained from a logarithmic plotting of runoff versus frequency in years. The main channels were designed to accommodate the peak flow for the 6-hour annual storm. Supplement "B" of Section 5, National Engineering Handbook, was used as a guide in determining the values of "n" in Manning's Formula.

Due to the presence of limestone in the channel bottom, no excavation will be performed on Spring Creek; however, clearing and snagging will be performed on all channels.

Hydrologic

Precipitation data were obtained from the U. S. Weather Bureau publication, "Climatological Data and Hourly Precipitation Data". The historical series was developed from 20 years of records for the recording gage at Lebanon, Tennessee. The maximum storm of the evaluation series began around 1:00 a.m., March 16, 1963, and ended around midnight of the same day. There was a total of 3.04 inches of rainfall which produced an estimated 2.71 inches of runoff. Of the total 3.04 inches of rainfall, 1.97 inches of the total storm fell in the last two hours.

Using data from field surveys, stage-discharge relationships at 26 valley cross-sections were calculated using Manning's Formula. In developing the maximum flood plain inundated, base hydrographs were flood-routed, using the Improved Coefficient Method, through six hydraulic reaches and routed peaks were compared with known flood marks. Stage-area inundation tables were developed for eight evaluation reaches by one-foot increments based on flood-routed hydrographs. The tables ranged from zero flooding to maximum flood plain inundated in the evaluation series. Peak rates of discharge at intermediate cross-sections were obtained from a logarithmic plotting of routed peaks versus drainage area.

Geologic

All available geologic maps and reports were reviewed for the purpose of noting geologic relationships. The composition of sedimentary layers, their lateral variations, and any other geologic condition which may affect the structural works were considered.

Preliminary investigations at the proposed floodwater retarding structure site was made with a refraction seismograph, hand auger, and inspection of outcrops and road cuts in the area.

This seismic investigation has indicated a thin overburden (0-15 feet) over limestone bedrock. From surface indications in the vicinity of the structure, caverns and solution channels in the limestone bedrock do not appear to be prevalent but some bedding planes and joints are present. Extensive caverns in the foundation are not expected; however, cavernous conditions beneath solid rock cannot be located by use of the refraction

seismograph and if any are present, they will be delineated in the detailed site investigation. The Soil Conservation Service anticipates that this floodwater retarding structure will maintain a permanent pool of water, but due to the above possible subsurface conditions, the Soil Conservation Service cannot guarantee that this structure will maintain a permanent pool of water.

Form SCS-375, Preliminary Geologic Investigation of Dam Sites, was compiled for the proposed structure. On this form, and in a narrative geologic report of Wilson Spring Creek Watershed, the geologic conditions peculiar to the area were discussed and geologic conditions that should be given special consideration during detailed site investigations were outlined.

Sedimentation

The calculations of gross erosion were made by use of Musgrave's Equation, land use and cover, percent slope, length of slope, and maximum two-year, 30-minute rainfall are factors used in these calculations to determine gross erosion under present conditions, and future conditions with the project installed.

Land use measurements were made of the area above the proposed floodwater retarding structure. These data were used in the procedure as outlined in Technical Release No. 12, Soil Conservation Service, Engineering Division, September 1959, to determine the required volume of sediment pools.

The area of the flood plain lands affected by scour damage were determined by mapping of the flood plain. Data gathered were processed and expanded for the reaches involved and summaries were prepared showing location and extent of these damages.

Land Use and Treatment

Soil surveys of the Wilson Spring Creek Watershed were made from 1943 to the present by soil scientists of the Soil Conservation Service. This mapping showed soil type, slope, and degree of erosion.

Present open land use of the uplands was determined by use of aerial photographs and by consultation with the local work unit conservationist. Present land use of the flood plain was determined by field mapping on aerial photographs.

The amount of land treatment now on the ground was determined from farm plans, plus field checks. The land treatment measures to be installed during the four-year installation period were determined from the local needs of the watershed.

Forestry

A systematic field survey by the U. S. Forest Service showed ground cover, forest and soil hydrologic conditions, and treatment needs. The amount of remedial measures was determined from this survey, supplemented

by data and information provided by local agencies and forestry officials. The forest land treatment measures recommended are based on total conservation needs adjusted for owner-participation and limited by the installation period of the watershed program.

Fish and Wildlife

A study and analysis of the Wilson Spring Creek Watershed was made by biologists of the Tennessee Game and Fish Commission, U. S. Fish and Wildlife Service, and Soil Conservation Service, working together and individually. The analysis included physical characteristics of the stream and watershed as related to the fish and wildlife resources, relative extent of fish and wildlife species and population, and relative hunting and fishing pressure and success.

The extent and composition of the fish and wildlife resources in the Wilson Spring Creek Watershed were determined by the Biology Work Group through interviews with the local Tennessee Game and Fish Commission Conservation Officers, and through observations and comparisons of this watershed with similar watersheds in Middle Tennessee where intensive studies have been made. The structural measures proposed for flood prevention and sediment storage were evaluated by the Work Group for the effect on the fish and wildlife resources.

Economic

The methods used in making economic investigations and analyses followed those approved by the Soil Conservation Service in benefit-cost evaluations on land and water resource projects. The methods followed are in accordance with instructions in the Economic Guide for Watershed Protection and Flood Prevention, and Economics in Watershed Planning for the Southeast. Basic data were obtained from local farmers, agricultural workers, State and County Highway officials, experiment stations, and agricultural publications.

Basic information was obtained by interview with landowners and operators having flood plain land and consisted of the following: present land use and yields; normal flood-free land use and yields; anticipated land use and yields with various degrees of flood protection; information concerning the normal sequence of the various farming operations; estimates of the percent damage to the various crops and pasture by depths of inundation by months or specific flood events; and damage to rural property and minor fixed improvements by depths of inundation or by specific storm events.

Long-term projected prices were used as a basis for benefit computations, cost of production and cost of operation and maintenance. These projected prices were developed from data furnished by the Agricultural Research Service and Agricultural Marketing Service, dated September, 1957. A 1964 price base was used as the basis for installation costs. The costs of land, easements, and rights-of-way were developed in meetings with the Watershed District sponsors. The unit costs of roads and bridges were developed in meetings with State and County Highway officials.

Benefits claimed from recreational use by organized groups or the general public for fishing, hunting, boating, swimming, camping, picnicking, hiking, and similar forms of water-related recreation were evaluated as an incidental effect of the proposed works of improvement and used in the economic justification of this work plan. Benefits are based on the number of visitor-days of use per year at a value of $0.50 per visitor-day where little, if any, basic facilities are provided for recreational purposes. User-days of incidental recreation were discounted at full level for 40 years, and declining to zero in 10 years in a 100-year evaluation.

Damageable values were calculated from appropriate summaries and from cost and price information. They were estimated on the basis of present land use and cropping practices and normal flood-free yields. The percent damage factors applied to this base gave damages by depth of inundation by seasons. Damageable values, stage-area, stage-damage relationships, flood series and information concerning erosion damage were used in determining average annual damage without and with the project.

Restoration to former productive use and more intensive land use benefits were estimated on the basis of the difference in net returns to crop and pasture with and without the project. These estimates were based on the information furnished by landowners and operators as to their intentions in regard to use of the affected lands with the project installed. However, in order to keep scheduled information within the land use capabilities of the soils, consideration was given to their potential productivity. A summary of the estimated restoration to former productive use and more intensive land use benefits is shown in the table on page 35.

The value of local secondary benefits stemming from or induced by the project were evaluated and used in project justification. Secondary benefits from a national viewpoint were not considered pertinent in the evaluation or justification of this proposed work plan. The total estimated local secondary benefits and the values used in the evaluation are shown in the following table:

ESTIMATE OF LOCAL SECONDARY BENEFITS

Items (1)	Total Amounts (2)	Percent of Total (3)	Local Secondary Benefits (4)
Direct Primary Benefits	44,826	10	4,483
Added Crop and Pasture Production Costs	19,422	10	1,942
GRAND TOTAL	xxx	xx	6,425

SUMMARY OF BENEFITS FROM RESTORATION TO FORMER PRODUCTIVE USE,
AND MORE INTENSIVE USE OF LAND
Wilson Spring Creek Watershed, Tennessee

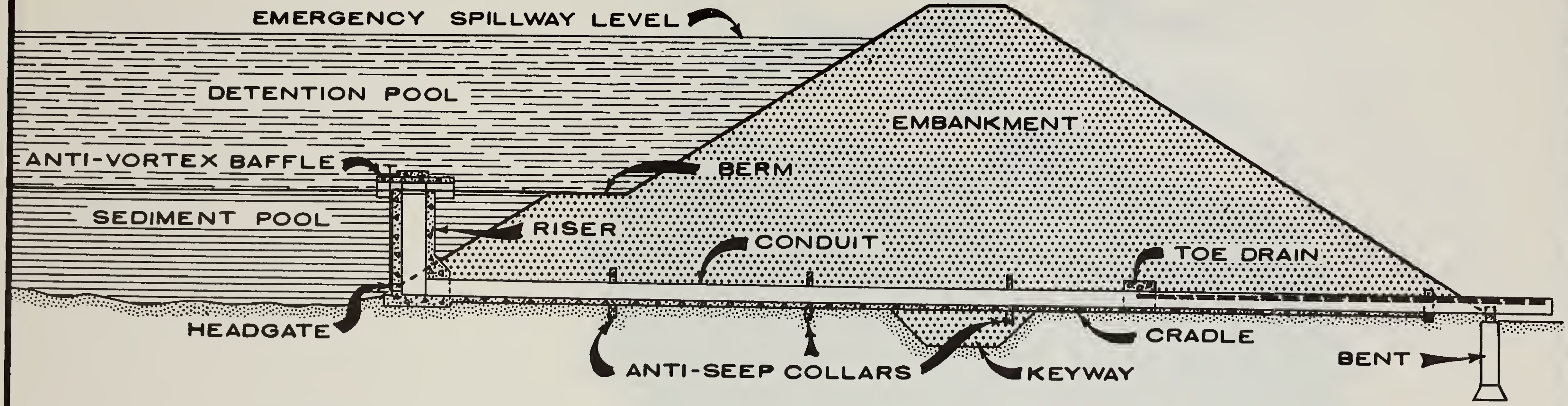
Land Use (1)	Present Conditions Acres (2)	Present Conditions Average Flood-Free Yield (3)	Present Conditions Net Returns (Dollars) 1/ (4)	Project Conditions Acres (5)	Project Conditions Average Yield (6)	Project Conditions Net Returns (Dollars) 1/ (7)
Tobacco	22	1,750 lbs.	5,770	22	1,910 lbs.	6,948
Corn	113	50 bu.	3,185	302	64 bu.	12,459
Silage	93	13½ Tons	5,352	169	15 Tons	11,306
Hay	743	1½ Tons	9,007	914	1.8 Tons	18,777
Pasture	1,847	4.8 AUMs	19,454	1,483	5.2 AUMs	18,943
Small Grain	(127)	22 bu.	859	(180)	28 bu.	5,070
Idle	72			0		
Total	2,890		43,627	2,890		73,503
Difference in Net Returns with and without project						29,876
Discounted difference in Net Returns						26,918
Less added flood damage to higher damageable values						1,363
Average annual benefits						25,555 2/

1/ Price base - long-term projected prices.
2/ Benefits from restoration to former productivity is $2,067, and more intensive use of land, $23,488.

JAN 1965

UNITED STATES
DEPARTMENT OF AGRICULTURE

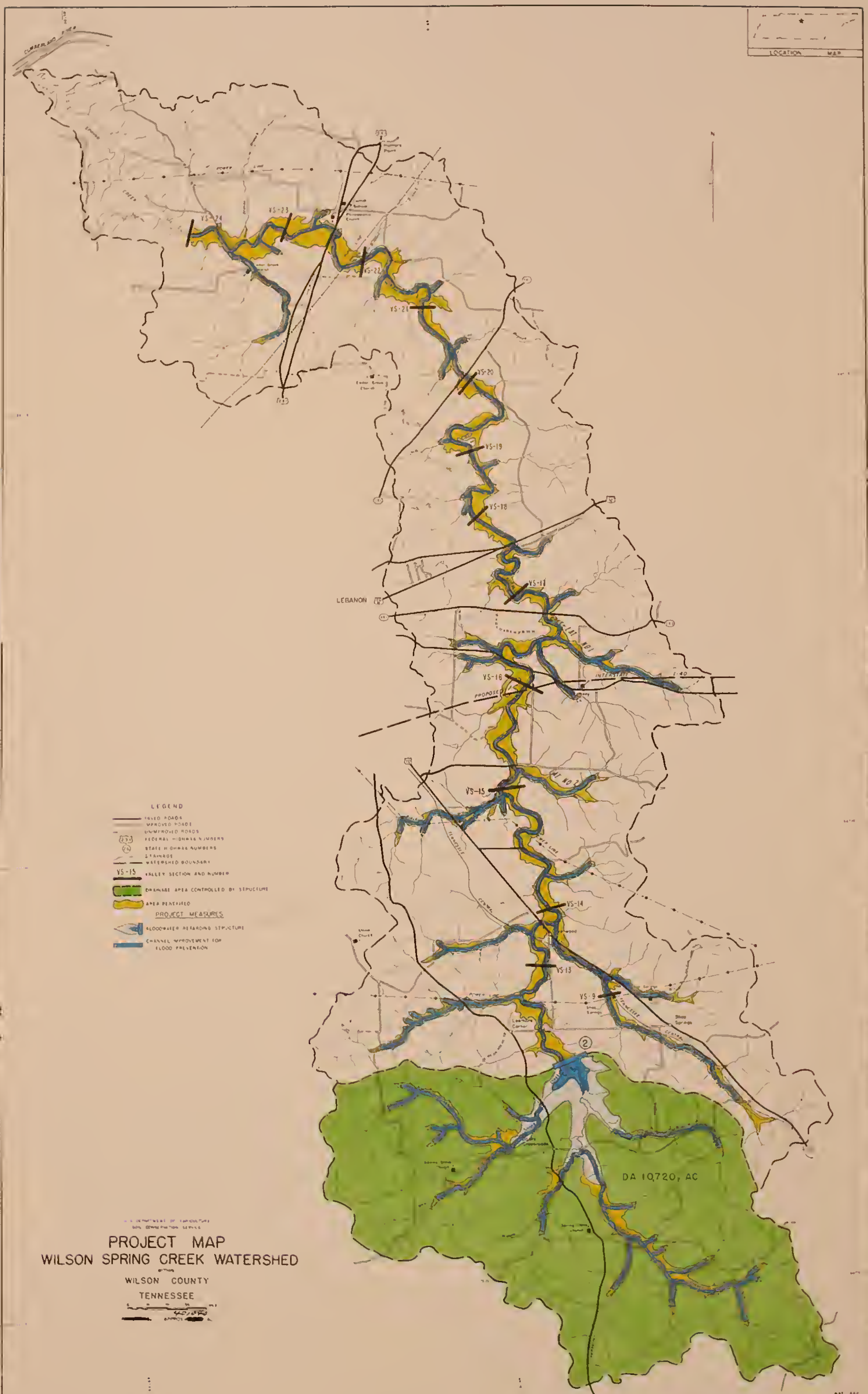
SOIL CONSERVATION SERVICE
SPARTANBURG, SOUTH CAROLINA



SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

AGR-SCS-SPARTANBURG. S.C. 1956 REPRINTED 1960

MR56-209



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP
WILSON SPRING CREEK WATERSHED

WILSON COUNTY

TENNESSEE